

## ABSTRACT OF THE DISCLOSURE

Neutron detectors, advanced detector process techniques and advanced compound film designs have greatly increased neutron-detection efficiency. One embodiment of the detectors utilizes a semiconductor wafer with  
5 a matrix of spaced cavities filled with one or more types of neutron reactive material such as  $^{10}\text{B}$  or  $^6\text{LiF}$ . The cavities are etched into both the front and back surfaces of the device such that the cavities from one side surround the cavities from the other side. The cavities may be etched via holes or etched slots or trenches. In another embodiment, the cavities are different-sized and the smaller cavities extend  
10 into the wafer from the lower surfaces of the larger cavities. In a third embodiment, multiple layers of different neutron-responsive material are formed on one or more sides of the wafer. The new devices operate at room temperature, are compact, rugged, and reliable in design.